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NPIC/TDS-28/67
23 March 1967

MEMORANDUM FOR: Chief, Development Staff, TDS
Chief, Production Services Division

SUBJECT : Interim Report on Drying Equipment

1. The attached summary and title page are provided for background information and to alert you that the report from which the pages were duplicated is in the CCB file in TDS, Rm. 4N412.

2. This report seems to be of special interest in view of the impending NPIC study of drying techniques scheduled in the FY-67 development program. Your people concerned with technical detail may borrow the subject report from [redacted] by citing PAR 100-6 [redacted] 25X1

3. I will continue to duplicate and distribute the index and summary of projects from the Quarterly Report on Contract [redacted] in order that you may be fully informed of the work performed under the cognizance of the CCB. 25X1

[redacted] 25X1

Executive Secretary,
COPE

Attachments

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This document contains
59 pages.

EB-46-700288-6
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PAR 100-6S

INTERIM REPORT

Drying Equipment

31 October 1966

Prepared by:

[redacted]

25X1

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Approved by:

[redacted]

Date: 3 March 1967

25X1

Contract [redacted]

PAR 100-6S

31 Oct 66

SUMMARY

This report summarizes an investigation of the design parameters for a photosensitive film drying system, operating at reduced ambient pressure, that will meet the film drying requirements of PAR 100-6S. The system chosen is of the air-impingement slot type, with unequal amounts of air flow on each side of the film. Sizes, operating conditions, and flow rates for a representative drying system were computed.

Although mechanical and desiccant subsystems for removing moisture from the recirculated drying air are discussed, it is now believed that a sufficient quantity of dry make-up air will be available, thus eliminating the need for either mechanical or desiccant water-removal devices.

An air-plenum design arranged to feed slot-type nozzles was selected as the dryer geometric configuration for the following reasons:

1. The calculated dryer mass-transfer coefficient applies only for the situation of a relatively close spacing between the individual impingement slots. A plenum air-feed system easily achieves this requirement and provides the low axial velocity which is necessary in order to achieve a uniform slot velocity profile. If slotted tubular plenums are used, the tubes must be sized large to provide low axial velocity. With these considerations the plenum approach results in a smaller (shorter) dryer.

2. The impingement, slot-type design provides a higher mass-transfer coefficient than does an impingement jet design approach. By utilizing nozzles to feed the slot, as opposed to locating the slot directly on the plenum wall, the necessary exhaust air plenum is automatically provided, external to the slots, for handling the return air flow. Further, a more uniform slot-velocity profile is achieved, and power requirements are decreased.

3. A design is easily achieved which gives nearly the same total air distribution to each slot. The plenum also serves to provide a uniform transverse velocity resulting in very little velocity-head differences from side to side across the film sheet. This situation establishes an even velocity profile along the nozzle width and eliminates problems of nonuniform drying across the film width.

4. The plenums provide an ideal location for the air filters by placing them immediately ahead of the last point the air passes before impinging on the film. The plenums also afford easy accessibility for maintenance of the filters and offer ample space for the large area (about 72 sq ft) needed to acquire the necessary low face velocity requirements of 85 percent efficiency filters. Hence, an otherwise difficult packaging problem, that of providing a large filter space, is easily solved. Further, when filters are located within the air-supply plenums, they also assist in producing uniform air distribution to the nozzles.

5. An ideal structural mounting framework is obtained for film conveyance rollers, anti-flutter rollers, and auxiliary equipment.

6. A flexible design is obtained in terms of future possible changes in nozzle spacing, air-flow quantity, plenum-pressure requirements, and air-flow routing.

7. Sound attenuation, through basic dryer construction principles (such as locating filters in the air-discharge plenums), is optimized.

8. Modular design is offered and is easily achieved.

The over-all design concept was planned with possible future increased dryer requirements in mind. All plenum dimensions and filter area requirements were sized to handle double the air flow needed for the present specification. The proposed dryer length is 24 feet as opposed to a calculated length of 13.7 feet which will be needed for the currently specified drying load. The entire design plan is based upon flexibility.

A small "breadboard" dryer was constructed to verify portions of the analysis. Preliminary tests demonstrated that nozzle flow rates (at atmospheric pressure) were as computed and that film could be transported past the nozzles without touching, even though an unbalanced air flow existed on each side of the film sheet.

This investigation was terminated prior to breadboard operation at reduced pressure, and no further analysis was made beyond what is contained in this report.